ANAPHYLAXIS REACTIONS BETWEEN PROTEINS FROM SEEDS OF DIFFERENT GENERA OF PLANTS*

THE BIOLOGIC REACTIONS OF THE VEGETABLE PROTEINS, VII

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Recent investigations have clearly shown that the specificity of the anaphylaxis reaction depends upon the chemical constitution of the protein, and not upon its biologic origin. The biologic specificity shown when animal fluids or vegetable extracts are used as antigens is consequently due to the fact that the protein constituents of these fluids, or extracts, are specific for each organism. The specificity of the anaphylaxis reaction is therefore an expression of the specificity of the proteins for the plant or animal from which the material for the experiments was derived. Whether this specificity which is revealed by the anaphylactic reaction implies identity of chemical constitution, or the presence of identical groups, or radicals, in the molecules of the proteins inducing this reaction, cannot be definitely settled until some method is discovered by which the chemical individuality of protein preparations can be positively demonstrated.

In numerous instances we have found that carefully purified preparations of a protein from one species can sensitize guinea-pigs to equally carefully purified preparations of physically and chemically similar, tho apparently structurally different, proteins from another species. Thus we have shown that guinea-pigs sensitized with gliadin from wheat are intoxicated with hordein from barley, the reaction being almost as strong as when they are intoxicated with gliadin from wheat. The same is true when the order of treatment is reversed.[1] Legumin from the pea renders guinea-pigs as sensitive to legumin from the vetch as it does to itself and vice versa. In other words these proteins, from seeds of different genera, behave anaphylactically as tho they were identical proteins.

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[1] Wells and Osborne: Jour. Infect. Dis., 1913, 12, p. 341.

In this paper we propose to discuss further the reactions obtained between proteins of similar chemical properties obtained from seeds of different genera. The results of experiments already published in our earlier papers are included in this discussion together with new experiments which have been made in order to obtain further data on this subject.

PROTEINS FROM LEGUMINOUS SEEDS

LEGUMIN

This, the principal protein obtained from the seeds of the pea (Pisum sativum), the vetch (Vicia sativa), the lentil (Ervum lens), and the horse bean (Vicia faba), has been the subject of much study. A comparison of carefully purified preparations from each of these four seeds has failed to reveal any differences, discoverable by chemical means, which are sufficient to show that they are not identical in constitution.[2]

TABLE 1

LEGUMIN

Substance	No Reaction	Doubtful	Slight	Moderate	Severe	Fatal	Protection
Pea + pea	2	1	1	6	2	0	
Vetch + vetch	2	2	3	5	1	2	
Lentil + lentil	0	0	0	0	2	0	
Horse bean + horse bean	0	0	0	0	1	1	
Pea + vetch	0	2	0	3	1	0	Incomplete
Pea + lentil	0	0	0	0	2	0	Complete?
Pea + horse bean	0	0	0	3	0	0	Complete
Vetch + pea	0	4	3	3	0	0	Partial
Vetch + lentil	0	0	0	0	0	2	No experiments
Vetch + horse bean	0	0	0	0	2	0	Complete
Lentil + pea	0	0	0	2	0	0	None
Lentil + vetch	0	0	0	1	1	0	None
Lentil + horse bean	0	0	0	1	1	0	Complete
Horse bean + pea	0	0	3	0	2	0	Partial
Horse bean + vetch	0	0	0	0	0	2	No experiments
Horse bean + lentil	0	0	0	0	1	1	Complete

Table 1 gives the results of anaphylaxis experiments which were made with pure preparations of legumin from each of these seeds. The methods of conducting these experiments and describing the results are the same as given in our first paper of this series.[3] The numbers in the table show the number of experiments that were tried, with the outcome indicated at the head of the column. The sensitizing dose was

[2] Osborne and Campbell: Jour. Am. Chem. Soc., 1898, 20, p. 410. Osborne and Heyl: Am. Jour. Physiol., 1908, 22, p. 423, and Jour. Biol. Chem., 1908, 5, p. 187.

[3] Wells and Osborne: Jour. Infect. Dis., 1911, 8, p. 66.

from 1 to 5 mg., the incubation period from 16 to 21 days, and the intoxicating dose from 50 to 100 mg. Animals recovering from the intoxicating dose were given a second dose of the same protein 24 hours later to assure saturation with this protein. After a further interval of from 48 to 72 hours they received from 50 to 100 mg. of the protein used for sensitizing to determine whether or not they had been protected by the heterologous protein.

These results show that preparations of legumin from each of these four seeds react with one another as tho they were homologous proteins, the number of severe or fatal reactions between the preparations of different origin being as great as when preparations from the same seed are used. While in most cases the guinea-pig was rendered refractory by the heterologous preparation, there were several cases in which no protection was afforded. In all the latter, except the reaction between legumin from the lentil and the vetch, the legumin from the pea was involved. The data given in the table indicate that the anaphylactogenic power of the pea legumin was somewhat less than that of the preparations from the other three seeds. A possible explanation may ultimately be found in the fact that the preparation of pea legumin used for these experiments had been subjected to repeated fractional precipitation from ammonium sulfate solution, whereas the other preparations had been purified by reprecipitation from sodium-chlorid solutions. There is no apparent reason why this difference in the method of purification should affect the result of anaphylaxis experiments.

These experiments are in harmony with the conclusion drawn from chemical comparisons that preparations of legumin from each of these seeds are, if not chemically identical, at least extremely similar to one another in their chemical constitution.

VICILIN

The seeds of the pea, lentil, and horse bean contain besides legumin a smaller amount of another protein known as vicilin. This differs from legumin in being coagulable by heat, and more soluble in very dilute salt solutions. It also has a slightly different ultimate composition and yields somewhat different proportions of some of the products of acid hydrolysis. It is very difficult to separate vicilin from legumin and furthermore there is no way in which to show that preparations of vicilin contain no legumin. Since seeds of the vetch yield no vicilin, animals sensitized with vetch legumin should not react when intoxicated with pea vicilin unless these heterologous proteins are capable of

reacting anaphylactically with one another. In the following table this is shown to be the case, pronounced reactions being obtained in nearly all of the experiments, altho the animals were not made refractory. When these experiments were tried with vicilin and pea legumin the reactions were far more severe than when the guinea-pigs were sensitized and intoxicated with pea legumin alone, possibly because vicilin is much more soluble in very dilute salt solutions than is legumin. Table 2 gives the results of these experiments.

TABLE 2

VICILIN

	No Reaction	Doubtful	Slight	Moderate	Severe	Fatal	Protection
Vicilin, pea + vicilin, pea..	0	0	2	1	4	2	
Legumin, vetch + vicilin, pea.....	0	0	0	5	1	3	None
Vicilin, pea + legumin, vetch.....	0	1	2	0	4	0	None
Legumin, pea + vicilin, pea.....	0	0	0	0	0	4	No experiments
Vicilin, pea + legumin, pea.....	0	0	0	0	1	3	No experiments

VIGNIN

The seeds of the cow-pea (Vigna catjang) contain a large proportion of a protein named vignin, which resembles legumin in chemical and physical properties, but differs sufficiently to leave no doubt that it is a distinctly different protein. The reactions given in the following table indicate that vignin may react with the similar heterologous proteins, legumin from the vetch, vicilin, and glycinin (from the soy bean), but the results of these experiments are irregular and cannot be explained by any of the facts known concerning these proteins. Only in the crossed reaction with vetch legumin are the reactions usually strong enough to be a satisfactory indication of relationship, while only with pea legumin can relationship be excluded by absence of reaction.

TABLE 3

VIGNIN

	No Reaction	Doubtful	Slight	Moderate	Severe	Fatal	Protection
Vignin + vignin.....	0	0	0	0	2	4	
Vignin + legumin, pea.....	0	4	0	0	0	0	None
Legumin, pea + vignin.....	0	8	0	0	0	0	None
Vignin + legumin, vetch.....	2	2	0	1	2	2	None or part
Legumin, vetch + vignin....	4	0	1	1	2	0	None
Vignin + vicilin, pea.....	0	0	4	4	0	0	?
Vicilin, pea + vignin.....	3	1	2	0	0	0	None
Vignin + glycinin.....	3	1	0	0	0	0	None
Glycinin + vignin.....	1	0	2	2	3	0	None

GLYCININ

The greater part of the protein of the soy bean (Soja hispida) has been named glycinin. It resembles legumin, vicilin, and vignin in most of its chemical and physical properties, but is not identical with any one of these proteins.

While guinea-pigs both sensitized and intoxicated with glycinin react severely, or fatally, there was no reaction when the experiments were made between glycinin and vetch legumin, or pea vicilin, sufficiently pronounced to indicate that these proteins react anaphylactically with one another.

Five of 8 animals sensitized with glycinin gave pronounced reactions when subsequently injected with vignin and 2 of the remaining 3 reacted slightly. There was no protection observed in the animals thus treated. The results of the reactions given in Table 4 show no reaction between glycinin and vicilin from the pea, or legumin from the vetch.

TABLE 4

GLYCININ

	No Reaction	Doubtful	Slight	Moderate	Severe	Fatal	Protection
Glycinin + glycinin.....	0	0	0	1	3	3	
Glycinin + vignin.....	1	0	2	2	3	0	None?
Vignin + glycinin.....	3	1	0	0	0	0	None
Glycinin + vicilin, pea.....	0	3	0	1	0	0	None
Vicilin, pea + glycinin.....	0	0	3	0	0	0	
Glycinin + legumin, vetch...	2	0	2	0	0	0	Partial
Legumin, vetch + glycinin..	5	0	0	0	0	0	None

PHASEOLIN

The kidney bean (Phaseolus vulgaris) yields a relatively large amount of protein soluble in dilute salt solutions, which has been named phaseolin. The Japanese adzuki bean (Phaseolus radiatus) likewise yields a protein so similar to that obtained from the kidney bean that a very careful comparison of purified preparations from these two sources has shown no differences in chemical and physical properties except a slightly larger proportion of basic nitrogen in those from the adzuki bean.[4]

As shown in Table 5, preparations from these two seeds did not react anaphylactically with one another and are consequently to be regarded as distinctly different proteins. It is striking that no reaction

[4] For the properties of these two proteins cf. Osborne, Jour. Am. Chem. Soc., 1894, 16, pp. 633, 703, 757; also Osborne and Campbell, ibid., 1897, 19, p. 509; also Osborne and Harris, ibid., 1903, 25, p. 336.

whatever should have been obtained between proteins apparently so similar and derived from seeds of plants so nearly alike that they have been assigned to the same genus.

TABLE 5

PHASEOLIN

	No Reaction	Doubtful	Slight	Moderate	Severe	Fatal	Protection
Phaseolin, adzuki bean + phaseolin, adzuki bean....	0	0	0	0	0	1	
Phaseolin, adzuki bean + phaseolin, kidney bean....	5	1	0	0	0	0	None
Phaseolin, kidney bean + phaseolin, kidney bean....	0	0	0	0	0	1	
Phaseolin, kidney bean + phaseolin, adzuki bean....	5	1	0	0	0	0	None

PROTEINS FROM SEEDS OF CEREALS

GLIADIN AND GLUTENIN FROM WHEAT, GLIADIN FROM RYE, HORDEIN FROM BARLEY, AND THE ALCOHOL-SOLUBLE PROTEINS FROM OATS AND SORGHUM

The seeds of wheat (Triticum vulgare) and rye (Secale cereale) contain proteins soluble in 70% alcohol which are so nearly alike in chemical and physical properties that the only positive difference between the preparations from these two seeds that has as yet been established is a somewhat higher specific rotation for those from rye. From this it is probable that the alcohol-soluble protein from wheat, gliadin, is not identical with that from rye.

The seeds of wheat also contain a considerable amount of another protein, glutenin, which is not soluble in 70% alcohol and in several other respects differs so much from gliadin as to leave no doubt that these two proteins are distinctly different.

The seeds of barley (Hordeum vulgare) contain a considerable amount of protein soluble in alcohol, hordein, which, tho resembling gliadin, has been shown to be distinctly different. The anaphylactic relations of these proteins have been so extensively discussed in the second paper of this series[5] that it is not necessary to comment on them further. In that paper we stated that "we must conclude from the results of our experiments either that our preparations of gliadin and hordein each contain two different proteins, one of which is common to both preparations, or that they contain at least two reactive groups, one of which is common to both proteins, each of which groups behaves as a distinct antigen when injected into guinea-pigs."

[5] Wells and Osborne: Jour. Infect. Dis., 1913, 12, p. 341.

Groh and Friedl[6] have recently concluded from a comparison of the physical properties of successive fractional precipitates of carefully purified gliadin that this consists of a single protein; hence it is now highly probable that the anaphylactic reactions between gliadin and hordein are due to the presence of common reactive groups in these chemically different proteins.

Preparations of protein soluble in relatively strong alcohol have been made from seeds of the oat[7] (Avena sativa) and also from those of the sorghum.[8] Neither of these proteins has been studied in detail and practically nothing is known about their chemical characteristics. Some anaphylaxis experiments have been made with crude preparations of the two latter proteins.

Table 6 summarizes the results of our experiments with these six proteins from seeds of different genera.

TABLE 6

SUMMARY OF THE RESULTS OF EXPERIMENTS WITH PROTEINS FROM SEEDS OF DIFFERENT GENERA

	No Reaction	Doubtful	Slight	Moderate	Severe	Fatal	Protection
Gliadin, wheat + gliadin, rye..	0	0	0	1	3	4	Incomplete
Gliadin, rye + gliadin, wheat..	1	0	0	0	4	2	?
Gliadin, wheat + glutenin, wheat.....	0	0	0	6	9	1	Incomplete
Glutenin, wheat + gliadin, wheat.....	0	0	0	0	7	1	Complete?
Gliadin, rye + glutenin, wheat	0	0	2	4	2	0	None?
Glutenin, wheat + gliadin, rye.....	4	0	4	1	0	1	Complete?
Gliadin, wheat + hordein, barley.....	0	1	0	1	8	1	None
Hordein, barley + gliadin, wheat.....	0	0	0	0	9	3	None?
Gliadin, rye + hordein, barley	0	0	0	0	4	0	None
Hordein, barley + gliadin, rye.....	0	0	0	0	3	1	None
Alcohol-soluble protein, oat + alcohol-soluble protein, oat.....	0	0	2	0	0	0	
Alcohol-soluble protein, oat + zein, maize.....	2	0	0	0	0	0	
Alcohol-soluble protein, oat + gliadin, wheat.....	2	0	0	0	0	0	
Alcohol-soluble protein, oat + hordein, barley.....	2	0	0	0	0	0	
Alcohol-soluble protein, oat + alcohol-soluble protein, sorghum.....	2	0	0	0	0	0	
Alcohol-soluble protein, sorghum + alcohol-soluble protein, sorghum.....	0	0	0	0	1	1	
Alcohol-soluble protein, sorghum + gliadin, wheat.....	2	0	0	0	0	0	None
Alcohol-soluble protein, sorghum + hordein, barley.....	2	0	0	0	0	0	None
Alcohol-soluble protein, sorghum + alcohol-soluble protein, oat.....	2	0	0	0	0	0	None

[6] Biochem. Ztschr., 1914, 66, p. 154.

[7] Osborne: Am. Chem. Jour., 1891, 13, pp. 327, 385; 1892, 14, p. 212.

[8] Not published.

JUGLANSIN AND CORYLIN

The American black walnut (Juglans nigra) and the hazel-nut (Corylus avellena) contain relatively large proportions of protein having the properties of globulin. They are very similar to one another in physical and chemical properties.[9] A careful comparison of these globulins, which have been named juglansin and corylin respectively, has revealed slight differences, which appeared to justify applying different names to them.[10] To determine whether or not this distinction was warranted we have tried the following experiments.

TABLE 7

RESULTS OF EXPERIMENTS WITH JUGLANSIN AND CORYLIN

	No Reaction	Doubtful	Slight	Moderate	Severe	Fatal	Protection
Juglansin + juglansin.....	0	0	0	0	0	2	
Corylin + juglansin.....	4	0	0	0	0	0	None
Corylin + corylin.....	0	0	0	0	0	1	
Juglansin + corylin.....	2	3	0	0	0	0	None

The fact that these proteins have high anaphylactic power, yet do not react when one is used for sensitizing and the other for intoxicating, nor develop any protection, may be taken as positive evidence that they are chemically different substances.

In Table 8 the results of a number of experiments are given in which proteins were used which presumably are distinctly different from one another, yet might possibly contain common anaphylactically reactive groups. The outcome of these experiments shows that these proteins have nothing in common, in so far as the anaphylaxis reaction is concerned.

TABLE 8

RESULTS OF EXPERIMENTS TO DETERMINE COMMON ANAPHYLACTICALLY REACTIVE GROUPS IN CORYLIN, EXCELSIN, AMANDIN, JUGLANSIN, AND HAZEL-NUT PROTEOSE

	No Reaction	Doubtful	Slight	Moderate	Severe	Fatal	Protection
Corylin + excelsin.....	2	0	0	0	0	0	None
Excelsin + corylin.....	2	0	0	0	0	0	None
Corylin + amandin.....	2	0	0	0	0	0	None
Amandin + corylin.....	2	0	0	0	0	0	None
Amandin + juglansin.....	2	0	0	0	0	0	None
Juglansin + amandin.....	2	0	0	0	0	0	None
Excelsin + juglansin.....	2	0	0	0	0	0	None
Juglansin + hazel-nut proteose.....	2	0	0	0	0	0	None

[9] Osborne and Campbell: Jour. Am. Chem. Soc., 1896, 18, p. 609.

[10] Osborne and Harris: Ibid., 1903, 25, p. 848.

GLOBULIN FROM FLAX SEED, AND EDESTIN FROM HEMP SEED

The flax seed (Linum usitatissimum) and the hemp seed (Cannabis sativa), contain relatively large quantities of protein soluble in salt solutions and having properties characteristic of globulins. These crystallize in octahedra and closely resemble one another in physical properties and in the proportion of the decomposition products which they yield on hydrolysis with acids. Distinct differences have, however, been detected between them, so that there can be no doubt that they are not identical.

The immunologic relationships between edestin and flax-seed globulin are unusual. White and Avery[11] sensitized two guinea-pigs with edestin, which reacted fatally when flax-seed globulin was injected intravenously (using 40 and 120 times the fatal dose of edestin). Lake[12] found (Experiment 11) that an antiserum for edestin which gave a positive complement-fixation reaction with edestin at 1 : 50,000, and a precipitin reaction at a dilution of 1 : 100,000, when injected into guinea-pigs, made them strongly sensitive (passive anaphylaxis) to

TABLE 9

EXPERIMENTS IN ANAPHYLAXIS

	Sensitizing Dose	Second Dose	Route*	Result	Protection Test Reaction
1.	Flax seed globulin	Edestin.....	Peritoneum	0	Moderate
2.	Flax seed globulin	Edestin.....	Peritoneum	0	Moderate
3.	Flax seed globulin	Edestin.....	Peritoneum	Slight	Moderate
4.	Flax seed globulin	Edestin.....	Peritoneum	Slight	Severe
5.	Flax seed globulin	Edestin.....	Heart	0	
6.	Flax seed globulin	Edestin.....	Carotid	Died, 2 min.	
7.	Flax seed globulin	Edestin.....	Heart	Slight	Severe
8.	Flax seen globulin	Edestin.....	Heart	0	Severe
9.	Flax seed globulin	Edestin.....	Heart	Slight	Severe
10.	Flax seed globulin	Edestin.....	Heart	Died, 90 sec.	
11.	Flax seed globulin	Edestin.....	Vein	Moderate	Moderate
12.	Flax seed globulin	Edestin.....	Heart	0	Died, 2 min., heart
13.	Flax seed globulin	Edestin.....	Heart	0	
14.	Flax seed globulin	Edestin.....	Carotid	0	
15.	Edestin.....	Flax seed globulin	Peritoneum	0	Moderate
16.	Edestin.....	Flax seed globulin	Peritoneum	0	Moderate
17.	Edestin.....	Flax seed globulin	Peritoneum	0	Moderate
18.	Edestin.....	Flax seed globulin	Peritoneum	Doubtful	Moderate
19.	Edestin.....	Flax seed globulin	Heart	Doubtful	Moderate
20.	Edestin.....	Flax seed globulin	Heart	Doubtful	Moderate
21.	Edestin.....	Flax seed globulin	Heart	Slight	Moderate
22.	Edestin.....	Flax seed globulin	Heart	Died, 4 min.	
23.	Edestin.....	Flax seed globulin	Heart	Moderate	Slight
24.	Edestin.....	Flax seed globulin	Heart	0	Died, 20 min., heart
25.	Edestin.....	Flax seed globulin	Carotid	0	
26.	Edestin.....	Flax seed globulin	Jugular	0	

* In the case of intravascular injections the dose was but 5 mg.

[11] Jour. Infect. Dis., 1913, 13, p. 103.

[12] Lake, Osborne, and Wells: Ibid., 1914, 14, p. 364.

edestin. This antiserum also gave a precipitin reaction with flax-seed globulin at 1:10,000 and complement-fixation at the same dilution. Evidently some relation exists here. We have performed anaphylaxis experiments as indicated in Table 9.

With these proteins we find that usually no crossed reactions are obtained, but in 18 experiments in which the heterologous protein was introduced directly into the blood of the sensitized animal, 3 fatal reactions, characteristic of anaphylaxis, were obtained. We are not prepared to explain these exceptional results.

COMPARISON OF CHEMICALLY DISTINCT PROTEINS OF THE SAME SEEDS

The data thus far discussed show that the typical and severe anaphylaxis reactions may sometimes be obtained when proteins isolated from seeds of different genera are employed for the sensitizing and intoxicating doses in the same animal. In nearly every case such reactions have been developed only by preparations of proteins so nearly alike that differences between them have not been detected by physical or chemical means, or the differences found have been so slight that it seems highly probable that the proteins concerned are very similar in chemical constitution.

The only cases in which positive reactions have been obtained between proteins which chemical tests have indicated to have distinct differences in their constitution are vicilin (pea) versus legumin (vetch); vignin (cow pea) versus legumin (vetch); hordein (barley) versus gliadin (wheat or rye); and gliadin (wheat) versus glutenin (wheat). Such reactions can be attributed to the existence of common reactive groups in these different proteins, evidence of which we have given in the second paper of this series.[13]

In the first paper[14] of this series a list of reactions was given on page 119 between proteins of different origin and apparently different constitution in which the outcome was such that these reactions were designated doubtful. Further investigations must be made before these irregular results can be explained.

Table 10 gives the results of experiments which we have made with preparations derived from the same seed but of doubtless different chemical constitution.

The slight reactions caused by several of the preparations from the same seed are in marked contrast to the severe reactions obtained when the homologous proteins were used, and may consequently be

[13] Wells and Osborne: Jour. Infect. Dis., 1913, 12, p. 341.
[14] Wells and Osborne: Ibid., 1911, 8, p. 66.

TABLE 10

RESULTS OF EXPERIMENTS MADE WITH PROTEINS FROM THE SAME SEED BUT OF DIFFERENT CHEMICAL CONSTITUTION

	No Reaction	Doubtful	Slight	Moderate	Severe	Fatal	Protection
Globulin, castor bean + proteose	0	0	2	0	0	0	None
Proteose, castor bean + globulin	1	2	0	0	0	0	None
Flax seed proteose + globulin	0	0	1	1	0	0	Partial
Flax seed globulin + proteose	0	0	1	1	0	1	None
Edestin + hemp seed proteose	0	0	2	0	0	0	None
Hemp seed proteose + edestin	2	0	3	0	1	0	None
Proteose, pea + legumin, pea	0	0	2	0	0	0	None
Protoproteose, pea + legumin, pea	0	1	0	0	0	0	Partial
Vicilin, pea + proteose, pea	1	1	0	0	0	0	Parital
Vicilin, pea + Protoproteose, pea	0	0	1	0	0	0	Partial
Legumin, pea + proteose, pea	1	1	0	0	0	0	Partial
Legumin, pea + Protoproteose pea	0	0	1	1	0	0	Partial
Proteose, lentil + legumin, lentil	4	0	0	0	0	0	None
Legumin, lentil + proteose, lentil	2	0	0	0	0	0	None
Proteose, soy bean + glycinin	0	0	2	0	0	0	Partial
Glycinin, soy bean + proteose	0	0	0	1	1	0	Partial
Globulin, adzuki bean + proteose	0	0	1	1	0	1	Partial
Proteose, adzuki bean + globulin	2	0	1	0	0	0	Partial

ascribed to an incomplete separation of the proteins. That this is highly probable is indicated by the few cases where more severe reactions are recorded, for such results occurred when the globulin was used for sensitizing and the proteose for intoxicating. Since the reversed reactions were much less severe and since the globulins, owing to the methods employed in their preparation, might easily contain traces of proteose, it is much more probable that these reactions were caused by incomplete separation of the two proteins than by a reaction between them.

CONCLUSION

Since chemically similar proteins from seeds of different genera react anaphylactically with one another, while chemically dissimilar proteins from the same seed in many cases fail to do so, we must conclude that the specificity of the anaphylaxis reaction depends upon the chemical structure of the protein molecule.